

Series Overview

The focus of this program is for girls to explore and learn more about the fields of science through fun, hands-on activities and experiments.

There are 4 90-minute sessions in this program that are age appropriate for girls in grades 4-8. Some of the activities involve more complex concepts and will require hands-on assistance from adults especially for younger girls. It is recommended that you practice each activity before facilitating with a group so you are aware of any issues/problems the girls might encounter.

Each activity fulfills national leadership outcomes from the Girl Scout Leadership Experience, where girls Discover, Connect, and Take Action. Girls achieve these outcomes through the three Girl Scout processes: Girl Led, Learning by Doing, and Cooperative Learning. An important piece of the activities is the reflection that you do with the girls at the end. Doing the reflection in an enjoyable way helps girls process and retain what they have learned through their Girl Scout experience.

Session 1: Imagine Yourself as a Detective

Supplies:

Start-up Activity:

- Lab Notebooks
- Pencils

Icebreaker:

- 5 items to add to the room

Activity 1:

- Pencils
- Ink Pads
- Fingerprint grid work sheet (1 per girl)
- Soap
- Water
- Magnifying glasses
- Types of fingerprints worksheet (a few copies)

Activity 2:

- Lab Notebooks
- Pencils

Activity 3:

You will need each of these supplies per group

- Data table
- Pencil
- Purple grape juice
- White vinegar
- Iodine
- 3 cups, each with 1 teaspoon of baking powder
- 3 cups, each with 1 teaspoon of flour
- 3 cups, each with 1 teaspoon of baking soda
- 3 cups, each with 1 teaspoon of the mystery substance
- 3 pipettes or eyedroppers
- Paper towels
- Sticky notes (to use as labels)

Start- Up Activity: Kick It Off

5 minutes

1. Introduce yourself! Let the girls know why you're excited to guide them through the experience.
2. Gather the girls and ask them to pull out their lab notebooks and draw a "scientist." Give only this guidance: "this is an exercise of preconceived notions!" After a minute or so, have the girls share their sketches. Most often, girls will sketch some variation of a man in a white lab coat.
3. **Say:** *Throw out that stereotype of a man in a white lab coat! Researchers have found that women and men don't differ on math and science abilities. You are just as capable as a man of making the world a better place through science- and making a great salary, too.*
4. Wrap up with an open discussion with the girls by **asking** the following questions:
 - a. What do scientists do?
 - b. How do you become scientists?
 - c. What role do scientists play in our everyday lives?

Icebreaker: Shake Up a Room

**Completes Step 1 of the Detective Badge*

15 minutes

1. **Say:** *Let's be super detectives! One of the most important skills to be a great detective is the ability to watch people and situations very closely, so let's test our skills.*
2. Have one girl take five items out of the room you are in, and have the rest of the group close their eyes. See if the rest of the girls can identify the five objects that are missing.
3. Have the same girl put the five items back into their place.
4. As the leader, add five items into the room, and see if the girls can identify the items you've added.
5. **Ask** the girls: How would watching closely help you become a great detective? *(Answer: by keeping a close eye out, you will be able to see clues you need to solve mysteries, and watch for anything suspicious.)*

Activity 1: Fingerprinting

**Completes Step 3 of the Detective Badge*

15 minutes

1. **Read** this scenario to the girls, "One evening you opened your diary and noticed a chocolate fingerprint smudge on the page describing your latest crush. You wonder who would have read your diary".
2. Share with the girls the different types of fingerprints and their characteristics. Refer to the 'Types of Fingerprints' page to discuss the three common types of fingerprints which are:
 - a. Loops
 - b. Ridges
 - c. Whorls
3. Provide each girl a copy of the Fingerprint Grid for her own fingerprints.
4. Next, have each girl roll each finger separately on the ink pad and then gently roll that finger onto the corresponding square on their handout.

5. After each girl has completed rolling all fingertips, wash hands with soap and water to prevent fingerprint smudging.
6. Next, have them examine their fingerprints with the magnifying glasses. Compare them to the three different types of fingerprints on the 'Types of Fingerprints' page.
7. Are they able to tell what types of fingerprints they have? Let them know that they can have a combination of the three different types of fingerprints between both of their hands.
8. Explain to the girls that fingerprints are really just patterns of tiny circles and ridges and valleys on the tips of fingers. They are there to help people get a better grip on smooth surfaces, but they are tiny so as not to interfere with a finger's sensitive ability to feel things. Each person's distinct fingerprint pattern was formed before birth. No two people have the exact same fingerprints – not even identical twins.

Activity 2: Communicate In Code

**Completes Step 2 of the Detective Badge*

20 minutes

1. **Ask** the girls if they know what Morse code is, and why people of the past and still in the present day use it? (*Answer: Morse code is a way to send messages with a system of dots and dashes. Each letter of the alphabet is given its own set of symbols, which can be written or made with short and long flashes of light and sound.*)
2. Girls get into groups of 3 or 4 and create their own "code" key and prepare a message using their special code.
3. Then give them time to switch with another group to figure out each other's messages.

Activity 3: Whodunit?

25 minutes

1. **Read** the following scenario to the girls: *Help! Grandma's been arrested! Detectives say she baked a cake with a metal file in it so that someone could use it to break out of jail! But sweet old Grandma would never turn to a life of crime! The cake in question was made with baking soda. Quick! Head to the crime lab to test the powder found on Grandma's apron. If it's something besides baking soda, she's innocent! Today's challenge is to solve the case of the mystery powder-the secret is in the science!*
2. Make labels for the powders and liquids using the example table found below and arrange in a grid on a table.
3. Get 3 cups containing each powder (9 in total), and line them up under their labels (see illustration). Your cups with the mystery substance come later!
4. Put 5 to 10 drops of grape juice in one cup of baking powder. What happens? Record your observations on the data table.
5. Now try the grape juice on the other two powders, recording your observations each time. In some cases, a chemical reaction will occur. Signs of a chemical reaction include foaming, fizzing, or a change in color. But sometimes no chemical reaction can be seen. Can you tell the difference?
6. Test all the liquids with all the powders and write your observations on the data table. Use a new pipette with each liquid.

7. Get 3 cups containing the mystery substance and line them up next to the grape juice, vinegar, and iodine. Test and record your observations. (Hint: the mystery powder is one of the three powders you already tested!)
8. Did your observations about the mystery substance match any of the three powders you tested? By comparing your data, can you figure out what the mystery substance is?
9. Explain your reasons. Did you prove Grandma's innocence? Remember: The cake at the crime scene was made with baking soda. Does the mystery substance found on Grandma's apron match it, or is it different?
10. Explain to the girls that a chemical will react in the same way every time, as long as the conditions are the same. You set up the experiment so that each powder was tested in exactly the same way. Then you observed the chemical reactions closely and recorded your data. When you drew conclusions about what the mystery substance was, your conclusions were supported by scientific evidence.

Clean-up
10 minutes

Fingerprint Grid

Name: _____

Right Thumb	Right Index Finger	Right Middle Finger	Right Ring Finger	Right Pinky Finger
Left Thumb	Left Index Finger	Left Middle Finger	Left Ring Finger	Left Pinky Finger

Types of Fingerprints I have:

1. Loops = _____
2. Whirls = _____
3. Ridges = _____

Types of Fingerprints



Loop



Whorl



Ridge

	Baking Powder	Flour	Baking Soda	Mystery Substance
Grape Juice				
Vinegar				
Iodine				

Session 2: Imagine yourself in a Lab

Supplies:

Icebreaker:

You will need each of these supplies per group

- 6 cups
- Water for cups 3, 4, & 5

Activity 1:

You will need each of these supplies per group

- Plastic bowl
- 3 paper cups (at least 16 oz. each)
- Plastic spoon
- Half a peeled banana
- 1 cup plus 4 teaspoons of water
- 2 teaspoons liquid soap
- 2 pinches salt
- 2 teaspoons rubbing alcohol (99% works best)
- Strainer
- Toothpicks

Activity 2:

- 2 glasses per group
- Warm water
- Dishwashing liquid
- Cooking oil
- Tablespoon
- Teaspoon

Closing Activity:

- Imagine Your Lab Career checklist, 1 per girl
- Pencils

Start- Up Activity: Kick It Off

5 minutes

1. Gather the girls and ask them to brainstorm things that were discovered in a lab. (Examples: Aspirin, cameras, DNA, X-rays, Vaseline, stainless steel, potato chips, microwave ovens.)
2. **Say:** *Discoveries happen when scientists find a solution to a problem, which may not have been obvious to others. To warm up our brains, here's a puzzle to solve that's all about coming up with a creative solution.*

Ice Breaker: Cup Puzzle

10 minutes

1. Invite the girls to work in teams of 4.
2. As the girls are getting into groups, line up 6 cups for each team with water in cups 3, 4, and 5.
3. **Say:** *Each team has a set of 6 cups. Your challenge is to rearrange the cups so they stand alternately, one empty, one full. But here's the catch: You can only move or touch one cup to achieve this! You'll have 5 minutes to solve this puzzle.*
4. Then give the girls time to solve the puzzle. After each group thinks they have solved the puzzle, reveal the solution (girls need to pour water from cup number 4 into empty cup number 1 and then return cup number 4 to its original position.)
5. Get the girls talking about their problem solving skills by **asking:**
 - a. Did the "no restrictions" prompt help move you forward?
 - b. What was your "aha" moment when you figured out the puzzle

Activity 1: DNA of a Banana

**Completes Step 3 of the Special Agent Badge*

30 minutes

1. Have the girls split into new teams of four.
2. Each group should have all the materials at their work station. (Be sure to place the rubbing alcohol in the refrigerator 30 minutes prior to the activity!)
3. Have the group take their half a banana and cut it into smaller pieces, and add it into a bowl with 1 cup of water. The girls can take turns mashing the banana and water together with a fork until smooth. Transfer the mixture into the first cup.
4. Add 2 teaspoons of liquid soap, 2 pinches of table salt, and 4 teaspoons of water into cup two. Slowly stir this mixture with a plastic spoon to dissolve the salt and the soap.
5. Pour the soap solution into the cup containing the banana mixture, and have the girls take turns stirring continuously with the spoon for a total of 5 to 10 minutes.
6. Place the strainer over the third paper cup, and pour the banana/soap mixture through the strainer into the third cup. This may take several minutes.
7. Use these several minutes to talk about DNA with the girls, some things you might **ask** are:
 - a. Is everyone's DNA the same? Why or why not?
 - b. How could DNA help a crime scene investigator solve a case?
8. Add 2 teaspoons of cold rubbing alcohol to the solution in the cup. Gently swirl the solution to mix the rubbing alcohol with the banana/soap solution. Look at the top layer and see if you can see the DNA appear. It has the appearance of white, stringy mucus.
9. After about 5 minutes, use a toothpick to remove the DNA from the top layer, or remove the DNA with a spoon, slowly tipping out the excess liquid.

Activity 2: Digesting Fats

10 minutes

1. Explain to the girls that you are going to be learning about how our body digests the fats and oils that we consume.
2. Fill the glasses $\frac{1}{2}$ full with warm water.
3. Add a tablespoon of cooking oil to each glass of warm water.
4. Add one teaspoon of liquid dishwashing liquid to one glass.

5. Stir both.
6. Ask the girls what they see happening.
7. **Explain:** during digestion, fats and oils are difficult to digest. Instead of dissolving, the fat and oil molecules clump into blobs which make it more difficult for the enzymes in our digestive system to work on them. In order to be easily digested, the fats and oils need to be emulsified (broken into tiny droplets) so that their molecules are more exposed to the enzymes. In our body, the fats and oils are emulsified in our small intestine.

Closing Activity: Careers in a Lab

20 minutes

1. Give each girl a copy of the Imagine Your Lab Career checklist. **Say:** *You experimented with DNA extraction and learned how your body digests fat. These are just some of the many amazing things scientists do in their labs each day. Can you imagine having one of the lab careers?*
2. Once the girls complete the career checklist, they may want to read over the careers they chose.
3. **Ask:**
 - a. What do you love to do? How could you turn that into a job in a lab?
 - b. How could you make a difference in the world if you were a...?
 - c. What kind of education do you think you'd need to...?
4. As the girls are packing up, invite the girls to think about how everyday interactions are like experiments they can use to understand themselves and their values. And share this thought:
 - a. "Your life is a laboratory for discovering the values you use as a leader."

Clean-up

10 minutes

Session 3: Imagine yourself as an Engineer

Supplies:

Activity 1:

You will need each of these supplies per group

- 6 foot pieces of foam insulation tubing (can pre cut if you wish)
- Tape
- Books
- Cardboard boxes of various sizes
- Scissors
- Box cutter
- Empty toilet paper roles
- Rolling pins (optional)
- Marble

Activity 2:

You will need each of these supplies per group

- 8 marshmallows
- 18 pieces of raw spaghetti
- 4 pieces of raw linguine (spaghetti and linguine should be same diameter)
- 1 paper clip
- 1 envelope and a scissors (to make hanging basket for coins)
- approximately 40 coins
- Lab notebooks and pencil to record observations

Activity 3:

- Lab Notebooks
- Pencils

Closing Activity:

- Imagine Your Engineering Career checklist, 1 per girl
- Pencils

Start-Up Activity: Kick It Off

5 minutes

1. Gather the girls and ask what they think engineers do. You might **ask**:
 - a. What do you think of when you hear the word "engineer?"
 - b. Do you know any engineers? What kind of work do they do?

Activity 1: Create a Roller Coaster

**Completes Step 3 of the Entertainment Technology Badge*

25 minutes

1. **Ask** the girls: How many of you like the thrilling adventure of roller coaster rides? Did you know that engineers work long and hard on creating these for you to have fun while staying safe? Let's create our own!
2. Break the girls into groups of four, so each team can work together to create their rollercoaster.
3. Cut 6-foot pieces of $\frac{3}{4}$ inch or 1 inch foam insulation tubing half lengthwise.
4. Tape together a track, starting at the edge of a table or a similar high place.
5. Use books, boxes, or rolling pins to make hills, toilet paper tube tunnels, and wherever imagination will take you! Use your marble to test the rollercoaster ride.

Activity 2: Marshmallow/ Spaghetti Bridge Challenge

15 minutes

1. Tell the girls that during this activity they are going to investigate the difference between the strength of bridges. Divide the girls into small groups. Then distribute the materials to each group and **give** them the following directions:
 - a. *Cut off the lower corner of the envelope for your coin basket.*
 - b. *Unbend one end of the paper clip to make a hanger and poke it through the top of your coin basket.*
 - c. *Construct two pyramids of equal size with your marshmallows and spaghetti.*
 - d. *Connect the pyramids with a single strand of spaghetti.*
 - e. *Hang your coin basket from the bridging piece of spaghetti.*
 - f. *Add coins one at a time to the basket.*
 - g. *Record the number of coins in the basket at the time the bridging spaghetti breaks.*
 - h. *Repeat the experiment three more times to get an average number of pennies needed to break the spaghetti bridge.*
2. Then **ask**: How do you think the results will change if you use linguine for the bridge instead?
3. **Say**: *Now test your hypothesis by repeating the experiment with the linguine as the bridge.*
4. **Ask**: *Was the round (spaghetti) or flat (linguine) shape stronger? (Answer: Circles are among the strongest shapes in nature. External and internal stress distributes itself evenly throughout a round structure. Spaghetti has a shape like a cylinder, while linguini is shaped like a flattened rectangle. A piece of spaghetti has the same strength in any direction it is bent. Linguini will bend more easily in one orientation than another.)*

Activity 3: Figure Out What's Working and What's Not

**Completes Step 3 of the Product Designer Badge*

20 minutes

1. Have each girl draw a product, for example, a back pack.
2. After they have drawn their product, ask the girls to label the products uses. An example can be a backpacks handles are to carry the things inside, but then some people also use it to clip pens onto it.

3. **Say:** *Sometimes problems occur when a part is used differently from how it's meant to be used, can you find some potential problems in your drawn product?*
4. Have the girls mark the areas where the user had trouble or made an adjustment to make it work for them.

Closing Activity: Engineering Careers

15 minutes

1. Give each girl a copy of the Imagine Your Engineering Career checklist. **Say:** *You collaborated to design and create your own rollercoaster. During the bridge challenge, you solved problems and worked together to answer questions, the way engineers do. Check out some exciting careers that use these same skills.*
2. Once the girls complete the career checklist, they may want to read over the careers they chose.
3. **Ask:**
 - a. Which of the "hot jobs" sounds most exciting? What kinds of scientists could these engineers team up with to do their jobs?
 - b. Did anything surprise you about engineering?
 - c. Are there things engineers could improve in your neighborhood or at your school? What?
4. As the girls are packing up, invite the girls to think about how leaders depend on teamwork to achieve great results-and teamwork starts with every girl having the confidence to share her skills. And share this thought:
 - a. "Connecting with others is vital to leaders and scientists."

Clean-up

10 minutes

Session 4: Imagine Saving the Planet

Supplies:

Activity 1:

You will need each of these supplies per group

- Vegetable oil
- Cocoa powder
- Clear plastic cups
- Water
- Aluminum roasting pans
- Scissors
- Paper towels
- Lab notebook
- Pens
- Clean up materials: string, polyester batting, cotton balls, craft sticks, drinking straws, and plastic teaspoons
- Pages 46-49 of volunteer guide

Activity 2:

- Dirty water, you can make it by adding cooking oil, food coloring, pieces of paper, and tiny pieces of Styrofoam to water
- 2-liter soda bottle cut in half (by an adult)
- Gravel
- Course sand
- Fine sand
- Cotton balls

Activity 3:

- Canvas bags (1 per girl)
- Fabric or permanent markers

Start- Up Activity: Kick It Off

5 minutes

1. Discuss environmental science. **Ask:**
 - a. What solutions have you seen or heard about for environmental problems?
 - b. What kinds of science might have been involved in those solutions?
2. Then **say:** *Environmental scientists work to help to make purification systems so people all around the world have clean drinking water. They also help clean up environmental disasters such as oil spills. Today you will take on the role of an environmental scientist to help resolve both of these issues.*

Activity 1: Oil Spill

25 minutes

1. **Say:** *On April 20, 2010, a deep water oil rig exploded, creating the largest oil spill in U.S. history. Each day, 62,000 barrels of oil leaked into the ocean, roughly the same amount of oil consumed daily in Delaware. The faulty well was finally capped and sealed on July 15, but not before an estimated 4.9 million barrels spilled into the ocean. Hundreds of scientists worked to find cleanup solutions-now is your turn to be an environmental scientist and design your own cleanup system. Your team will compete to find the best system to contain and clean up an oil spill, using a variety of materials to simulate real methods.*
2. Step 1: Oil Spill!
 - a. Mix 1 cup oil with 2 teaspoons cocoa powder in a plastic cup to make “crude oil.”
 - b. Fill one of your pans $\frac{1}{2}$ full with water.
 - c. Dump the crude oil into the pan-that’s your spill! Record your estimate of how much water is covered with oil.
3. Step 2: Develop your System
 - a. With your team, decide how to use the available materials to clean up the spill.
 - b. Consider the approaches listed in the table on page 42 of your book as you plan. You might use more than one method.
 - c. NOTE to facilitator: It is important to remind girls that they won’t be testing their materials, so they have to make hypotheses about which materials will be most effective.
4. Step 3: Cleanup!
 - a. **Say:** *When I give you the signal, begin your cleanup. You’ll have ten minutes.*
 - b. *Use your chosen materials and techniques to remove as much oil as possible. (Put used materials and removed oil in your other pan.)*
 - c. *Record each step so you can compare results with your fellow environmental scientists! You’ll want to be able to describe the overall approach, specific steps, and materials used in your cleanup system.*
 - d. NOTE to facilitator: Give girls a heads up when they have five minutes left- and when they’re down to their last minute.
5. Step 4: Check out the Competition
 - a. Explain your team’s system to the group. Be sure to share your original estimate of the surface area covered in oil, so teams can evaluate your cleanup accurately!
 - b. Evaluate and score each system (including your own team’s).
 - c. Discuss the winning team’s system. **Ask:** Why do you think it was so effective? Could it be replicated on a large scale? Is this system also the most cost effective?

Activity 2: DIY Water Filter

25 minutes

1. Have girls break into groups of 3. Girls work together to make their own water filter in order to transform their dirty cup of water into cleaner water.
2. Put the top half of the soda bottle upside-down (like a funnel) inside the bottom half. The top half will be where you build your filter; the bottom half will hold the filtered water.
3. Layer the filter materials inside the top half of the bottle. Think about what each material might remove from the dirty water and in what order you should layer the materials. For an added challenge, use only two of materials to build your filter.
4. Pour the dirty water through the filter. **Ask:** What does the filtered water look like?
5. Take the filter apart and look at the different layers. **Ask:** Can you tell what each material removed from the water?
6. Wipe the bottle clean and try again. Try putting materials in different layers or using different amounts of materials
7. Wrap up by **asking:** are there better materials for cleaning water?

Activity 3: Green bags

20 minutes

1. **Explain** that *recycling is very important to ensure the survival of our planet Earth. Each year thousands and thousands of materials are thrown away which end up in landfills. One item that can be recycled that ends up in landfills, is plastic bags. During this activity, the girls are going to decorate their own canvas bags that can be used instead of a plastic bag.*
2. Give each girl her own canvas bag.
3. Have each girl decorate their canvas bag any way they would like.
4. Read these facts as the girls are decorating their bags;
 - a. *According to the Natural Environment website, 60 to 100 million barrels of oil are required to manufacture a year's worth of plastic bags worldwide, and it takes approximately 400 years at least for a bag to biodegrade.*
 - b. *The impact of plastic bags on the environment is enormous. As of August 2010, between 500 billion and 1 trillion plastic bags are being used each year worldwide.*
 - c. *Approximately 100,000 sea turtles and other marine animals die every year because they either mistake the bags for food or get strangled in them, says Natural Environment.*
 - d. *By using reusable bags instead of plastic bags, you can help cut down on the production and waste of plastic bags.*
5. Encourage a discussion among the girls of other ways they can improve their environment.

Clean-up

10 minutes